

Amendments to the Claims:

This listing of the claims will replace all prior versions, and listings, of the claims in the application:

- 1 1. (Original) A method for providing rotational leg control during a swing phase of a
2 robotic locomotion device, the method comprising:
3 computing an apex height return map of two consecutive flight phases for
4 different angles of attack;
5 selecting all pairs of leg angle and apex heights that result in a desired apex
6 height of a next consecutive flight phase;
7 for each leg angle-apex height pair, computing the corresponding flight times
8 from apex to touch-down; and
9 storing dependencies between flight time after apex and leg angle for any
10 desired consecutive apex heights.
- 1 2. (Original) The method of claim 1 further comprising determining an instant of apex
2 during flight phase by a vertical take-off velocity.
- 1 3. (Original) The method of claim 2 further comprising controlling the angular leg
2 orientation using the stored time dependencies for a desired apex height.
- 1 4. (Original) The method of claim 3 wherein controlling the angular leg orientation
2 begins starting at apex.
- 1 5. (Original) The method of claim 1 wherein computing an apex height return map of
2 two consecutive flight phases for different angles of attack comprises computing a
3 distinct map for each of a plurality of different mechanical energy levels.

- 1 6. (Original) The method of claim 4 wherein controlling the angular leg orientation
2 using the stored time dependencies for the desired apex height starting at apex,
3 includes controlling the angular leg orientation such that the leg will reach the next apex
4 in response to the leg contacting a surface at any time before or after an expected time.
- 1 7. (Original) The method of claim 4 further comprising at least one of: protracting the
2 leg after the time to apex and retracting the leg after the time to apex.
- 1 8. (Original) The method of claim 3 wherein controlling the angular leg orientation
2 includes moving the leg to a desired leg orientation at time to apex.
- 1 9. (Original) The method of claim 8 wherein controlling the angular leg orientation
2 begins starting at apex.
- 1 10 (Original) A method of moving a leg of a robotic system, the method comprising:
2 determining a time to apex;
3 selecting an angle of attack based upon time after apex; and
4 providing rotational leg control continuously during the time after apex until touch-
5 down occurs such that the leg is at a desired angle of attack when touch-down occurs.
- 1 11 (Original) The method of Claim 10 wherein determining a time to apex comprises
2 computing a time series.
- 1 12. (Original) The method of Claim 10 wherein selecting an angle of attack based upon
2 time after apex comprises retrieving an angle of attack from a lookup table based upon
3 time after apex.

- 1 13. (Original) The method of Claim 12 further comprises providing a lookup table
2 having stored therein values corresponding to a mapping of apex heights of two
3 consecutive flight phases for different angles of attack.
- 1 14. (Original) The method of Claim 13 wherein providing a lookup table comprises
2 providing a lookup table having stored therein a map of apex heights of two consecutive
3 flight phases for different angles of attack for one or more mechanical energy levels of
4 the robotic system.
- 1 15. (Original) The method of Claim 10 further comprising providing a lookup table that
2 projects all possible apex heights to a desired apex height in a next flight phase.
- 1 16. (Original) The method of Claim 15 further comprising selecting the desired apex
2 height.
- 1 17. (Original) The method of Claim 16 wherein providing rotational leg control
2 comprises providing rotational leg control starting at apex.
- 1 18. (Original) The method of claim 10 wherein determining a time to apex comprises:
2 computing a vertical take-off position; and
3 computing a vertical velocity at take-off from leg angle and leg length.
- 1 19. (Original) The method of claim 18 further comprising:
2 using the time to apex to determine an angle of attack in a lookup table that
3 associates a mapping of the apex height to the desired apex height with the angle of
4 attack.
- 1 20. (Original) The method of claim 18 further comprising:

2 computing the angle of attack from the computed apex height and desired apex
3 height.

1 21. (Original) The method of Claim 20 further comprising:

2 computing a vertical position and velocity at take-off from the leg angle and leg
3 length;

4 computing an instant of apex within the flight phase from the vertical velocity at
5 take-off;

6 computing mechanical system energy at take-off from the horizontal and vertical
7 velocity at take-off and the vertical position at take-off; and

8 using the mechanical system energy at take-off and the instant of apex to
9 determine a continuous adjustment in leg rotation that produces the angle of attack.

1 22. (Original) A robot comprising:

2 a body;

3 a leg coupled to the body;

4 a sensor, coupled to the leg, to provide a control signal indicating detection of a
5 contact phase of the leg;

6 a sensor, coupled to the body and the leg, to provide a control signal indicating
7 the leg orientation;

8 a sensor, coupled to the leg, to provide a control signal indicating the leg length;

9 a controller, coupled to the body and responsive to the control signals, to
10 determine for a next contact phase an angle of attack to reach a desired apex height in
11 a flight phase following the next contact phase; and

12 an actuator, coupled to the controller and the leg, to adjust orientation of the leg
13 during a flight phase occurring between the contact phase and the next contact phase
14 to achieve the angle of attack.

1 23. (Original) The robot of Claim 22 further comprising a memory, coupled to the
2 controller, said memory having stored therein values corresponding to dependencies
3 between flight time after apex and leg angle for any desired consecutive apex heights.

1 24. (Original) The robot of claim 23 wherein said controller controls the angular leg
2 orientation by retrieving stored time dependency values for a desired apex height from
3 said memory.

1 25. (Original) The method of claim 24 wherein said controller begins controlling the
2 angular leg orientation starting at apex.

1 26. (Original) The robot of Claim 25 wherein the values stored in the lookup table
2 correspond to values for a given system energy.

1 27. (Currently Amended) A method for providing rotational leg control during a swing
2 phase of a robotic locomotion device, the method comprising:

3 identifying kinematic control elements of the leg;

4 identifying energetic control elements of the leg to control system energy within
5 the robotic locomotion device; and

6 separating the kinematic control elements of the leg from the energetic control
7 elements of the leg.

1 28. (Currently Amended) AThe method for providing rotational leg control during a
2 swing phase of a robotic locomotion device, the method of Claim 27, further comprising:

3 identifying kinematic control elements of the leg;

4 identifying energetic control elements of the leg;

5 separating the kinematic control elements of the leg from the energetic control
6 elements of the leg;

7 determining an energetic control level of the leg to control system energy within
8 the robotic locomotion device; and
9 determining a kinematic control level of the leg to provide a desired energetically
10 possible movement trajectory within one step.

1 29. (New) The method of claim 28 wherein identifying energetic control elements of the
2 leg further comprises identifying energetic control elements of the leg to control system
3 energy within the robotic locomotion device.

1 30. (New) The method of claim 27 further comprising:
2 determining an energetic control level of the leg to control system energy within
3 the robotic locomotion device; and
4 determining a kinematic control level of the leg to provide a desired energetically
5 possible movement trajectory within one step.